F-8164 CIP

BLADE AND WING CONFIGURATION

Cross-Reference to Related Application:

This application is a continuation-in-part of copending United States Patent Application No. 10/208,565, filed July 30, 2002.

Background of the Invention:

Field of the Invention:

The invention lies in the field of fluid dynamics. In particular, the invention pertains to a dynamically optimized configuration for blades of watercraft propulsion propellers, stationary fluid propellers, aircraft propellers, and aircraft wings.

In a series of earlier patents, including U.S. Patent Nos. 6,164,919; 6,168,384; and 6,095,457, the inventor of the present application presented a novel concept for propeller blade configurations and airfoil and wing configurations. The concept provided for the surfaces of propeller blades and the like, which had previously been rounded along a slight curve in one direction, to be shaped along a tangent or a sine function. That is, a cross-section of the propeller blade at any line substantially perpendicular to a longitudinal axis of the configuration would show a double-curved shape which can be best described with a sine function and/or a tangent

function. The earlier disclosures of U.S. Patent Nos. 6,164,919; 6,168,384; and 6,095,457 are hereby incorporated by reference.

Summary of the Invention:

While those earlier patents provide considerable advantages in a variety of speed ranges, the present invention proposes another novel configuration for propeller blades and the like and also provides a novel structure at the trailing edge of the blades or wings.

With the foregoing and other objects in view there is provided, in accordance with the invention, a blade or wing configuration, comprising:

a leading edge with respect to a direction of movement of the blade or wing;

a trailing edge; and

an upper surface and a lower surface extending from the leading edge to the trailing edge, at least one of the upper surface and the lower surface being formed with a curved segment and a straight segment, the curved segment starting from a starting point on the at least one of the upper surface and the lower surface between the leading edge and the trailing edge and ending at the leading edge, the straight segment extending from the starting point to the trailing edge

in a tangent direction at the starting point, a tangent at the leading edge being substantially parallel to the direction of movement, and the straight segment forming an angle θ of approximately 30°-60° with respect to the direction of movement.

In accordance with an added feature of the invention, the starting point is located substantially equidistantly between the leading edge and the trailing edge.

In accordance with an additional feature of the invention, the angle θ is preferably approximately 45°.

In accordance with a further feature of the invention, a tangent angle at each point of the curved segment, with respect to the direction of movement, changes from approximately 30°-60° at the starting point to 0° at the leading edge gradually and continuously.

In accordance with again an added feature of the invention, the trailing edge is formed with teeth.

In accordance with again an additional feature of the invention, the teeth have a depth of up to one half of a length of the straight segment.

In accordance with again another feature of the invention, the teeth have a triangular, conical, or trapezoidal cross-sectional shape and the like.

The term propeller, herein, refers to propulsion propellers and impellers, such as for water propellers and for aircraft propellers (propulsion props, turbine blades, helicopter blades), as well as to stationary propellers and impellers used in high-power fans (wind tunnels, high velocity fluid pumps) and stationary turbines.

The term wing pertains to fixed wings and airfoils for fixed wing aircraft as well as gliders and glider wings for helicopters and the like.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in an airfoil configuration, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages

thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

Brief Description of the Drawings:

Fig. 1 shows a cross-section taken through an airfoil structure according to the invention;

Fig. 2 uses a Cartesian plane to show the curvature of the surface of the airfoil;

Fig. 3A is a diagrammatic plan view of a propeller blade with a tooth-shaped trailing edge, in which the leading and trailing edges are straight;

Fig. 3B is a diagrammatic plan view of a propeller blade with a tooth-shaped trailing edge, in which the leading and trailing edges are curved; and

Figs. 4A-4C diagrammatically show some examples of different shapes of the tooth-shaped trailing edge.

Description of the Preferred Embodiments:

Referring now to the figures of the drawing in detail and first, particularly, to Fig. 1 thereof, there is seen a cross-section taken through a blade or wing configuration according

to the invention. The blade or wing 1 has a leading edge 2 and a trailing edge 3 with respect to a moving direction 4 of the blade or wing, and an upper surface 5 and a lower surface 6 extending from the leading edge 2 to the trailing edge 3. The upper surface 5 and the lower surface 6 have substantially the same curvature, but offset and merge at the leading edge 2 and the trailing edge 3.

Referring now specifically to Fig. 2 in which the curvature of the upper surface 5 is depicted in a Cartesian plane. The moving direction 4 of the blade or wing 1 is parallel to the X-axis of the Cartesian plane. As shown in Fig. 2, the upper surface 5 has a curved segment 7 and a substantially straight segment 8. The curved segment 7 starts from a starting point P having a tangent 9 forming an angle θ with respect to the X-axis of the Cartesian plane in the range of about 30°-60°, preferably 45°, and ends at the leading edge 2 having a tangent 10, which is substantially parallel to the X-axis of the Cartesian plane. In other words, the tangent 10 at the leading edge 2 forms an angle θ of approximate 0° with respect to the X-axis of the Cartesian plane. The angle θ changes from 30°-60° at the starting point P to about 0° at the leading edge 2 gradually and continuously. The straight segment 8 extends substantially straight from the starting point P until the trailing edge 3 in a direction coinciding with the tangent 9 at the starting point P. The length of the straight segment 8 and the length of the curved segment 7 can

be chosen according to different air condition, but are preferably to be approximately the same.

As shown in Fig. 3A, the trailing edge 3 of the blade or wing 1 is formed with teeth in order to reduce the vortex in the area. By using tooth-shaped trailing edge, only small eddy currents will be formed and large eddy drag can be effectively eliminated. The teeth can be formed with a depth d of up to one half of the length of the straight segment 7. The teeth can be of a variety of different cross-sectional shapes, for example, triangle (Fig. 4A), cone (Fig. 4B), and trapezoid (Fig. 4C), etc.

In Fig. 3A, the leading and trailing edges are substantially straight. The tooth-shaped trailing edge can also be applied to an airfoil with curved leading and trailing edges as shown in Fig. 3B (the curved leading edge structure is described in the pending U.S. Patent Application No. 10/208,565 of the inventor of the present invention, which is hereby incorporated by reference).